

NOTES ON INSECTS ASSOCIATED WITH LUPINUS
POLYPHYLLUS LINDL. IN THE PACIFIC NORTHWESTL. P. ROCKWOOD¹

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About thirty years ago the writer, with some assistance,² studied the insects associated with a native lupine, *Lupinus polyphyllus* Lindl. (Piper and Beattie 1915). This lupine frequently occurs on the edges of wet unplowed meadows in the Tualatin Valley, a western arm of the Willamette Valley in Oregon. The stems, sometimes four or five feet tall, with their long racemes of pale violet flowers and large palmate leaves are conspicuous in the plant associations in which they occur. The stems are $\frac{3}{8}$ inch or more in diameter, thick-walled, and hollow except for a few inches of solid pith at the base.

Now that the writer has the time and inclination to return to his notes on the interesting group of insects associated with this plant, this lupine has disappeared from some of the nearby places where it formerly was abundant and in other places it has been damaged by the trampling of cattle. Hence the deductions from the original observations on the habits of certain of the insects infesting it, which were doubtful in some cases, cannot now be verified. However, as no information has been published on most of the species of insects, at least five of which were not known before our material was sent to taxonomists, it seems worth while to record the original observations.

The abundance of nicks in the edges of the leaflets first attracted the writer's attention to this plant in May, 1918. It was soon noted that the nicks were caused by the feeding of a large sitona beetle, which was identified as *Sitona californica* Fahraeus by W. D. Pierce in 1919. Upon further investigation in May, 1919, stem maggots were found in the bases of the flower stalks and a lepidopterous borer, which caused the large palmate leaf or the flower raceme to wilt, was present in the stems. Later other maggots were found in the stems and lepidopterous and coleopterous miners in the roots. In all, 10 species of probably injurious insects were

¹Retired October 31, 1948.

²Mrs. S. K. Zimmerman (*née* Keen) and Max M. Reeher.

noted on this host plant. In addition, a small, black sphecoid wasp and a leaf-cutting bee with its nearly-related inquiline were found utilizing the large stems as nesting places, after the stems had been damaged by other insects.

LEPIDOPTERA

PAPAPEMA PERTINCTA Dyar

Of the Lepidoptera the most interesting species was a stem borer that Dyar (1920) described as *Papaipema pertincta* from moths that had been reared from this host plant. The first indication that larvae of this species were at work was the wilting of the large leaves or the flower stalks in May. When the stems were split, the small larvae, probably then only in their first or second instar, were discovered actively feeding up and down inside the hollow stems, eating into the side walls as they went, even up close to the tip of the flower stalks. In spite of their small size, the larvae seriously affected the circulation in the large stems, causing them to wilt.

At this time the larva was a very active semi-looper, Van Dyke-brown with conspicuous whitish dorsal and subdorsal lines on the last two thoracic and last five abdominal segments, with the dorsal line only faintly indicated on the intervening segments. The thoracic shield and head were shining straw-color with a Van Dyke-brown streak on the sides of the face prolonged onto the thoracic shield.

As the larvae continued to work, the stems of the plant often broke off at points weakened by their feeding. By July the larvae were full-grown and were located in the stalk at the crown. This part of the stalk was originally solid pith but had been eaten out to form a pupation chamber. In each case a hole for emergence of the moth had been eaten in the stem well above the pupation chamber and about an inch above the surface of the ground. Frass had been expelled through this hole.

On August 7, 1924, a prepupal larva was described as follows: 36 mm. long by 6 mm. wide, dully shining, dirty white, without lines; head chestnut brown, thoracic shield auburn with black lateral margins, the median pale line faint; setae black on dark brown spots, spot around seta I, on abdomen, about three times as large as that around II except on abdominal segment 8 where both are transverse and subequal, the transverse oval spots around setae I and II cover most of the dorsum on abdominal 9, spot around seta III about like the one around II, that around III^a small

but distinct, the one around IV larger than the one around I, those around setae V and VI large, subequal, but paler; anal shield raw umber; tarsi almost black; proleg plates large but pale; claws black; spiracles black.

Pupation occurred in early August and the moths emerged in September. This species was parasitized in the early stages by an undetermined species of *Sagarites* and in the later stages by the braconid *Microplitis gortynae* Riley (determined by C. F. W. Muesebeck in 1922), the gregarious larvae of which emerged from the prepupal larva and spun their cocoons in the pupation chamber.

HYSTRICOPHORA PARADISIAE Heinrich

Another lepidopteron was a miner in the roots. This species did not come to our attention until we had dug up and caged the crowns and part of the roots of several of the plants to obtain pupae of the stem borer. Considerable numbers of pupae were found the following spring projecting from mines in the roots. A few of these root borers, in the larval stage, were later found in roots of the older plants. Pupal cases, with one end stuck in the ground and standing upright but empty, were found around the plants in the field. In the laboratory, moths emerged in May of the year following collection. Upon examination of the root crowns from which they had issued, it was found that very little sound plant tissue was left. The pupal chambers had been formed just under the surface of the root and were lined with white silk. An exit hole had been formed, through which the pupa had forced its way before the moth emerged. This species was determined by Carl Heinrich in 1922 as *Hystricophora paradisiae*, and was described by him (Heinrich, 1923) from specimens taken in Paradise Valley on Mt. Rainier in Washington.

COLEOPTERA

SITONA CALIFORNICA Fåhraeus

The coleopteron *Sitona californica* was usually rather abundant wherever this lupine occurred. The typical feeding notches of the adults on the edges of the leaflets were often so numerous as to give the leaflets the appearance of being irregularly dentate. Copulation and oviposition were observed in May. The eggs were often laid on the stems near the ground. The short-oval (nearly round) eggs are white at first but turn black if fertile (like those of all other sitonas known). The larvae feed on the large nodules on the roots.

These nodules are much larger than those on other leguminous plants, and this species of *Sitona* is larger than any other found in the region. The larvae reach maturity in July and pupate near the surface of the ground. The adults probably emerge in July.

ANOPLODERA INSTABILIS Haldeman

Occasionally coleopterous larvae were found in mines in the roots in July and August. These larvae were recognized as cerambycids, but the species was not reared until May 30, 1928, when adults emerged from roots collected in August, 1927. The adults were determined as *Anoplodera instabilis* by W. S. Fisher in 1930.

APION sp.

An undetermined species of *Apion* was observed on the flowers of the lupine in May and June.

DIPTERA

EREMOMYIA sp.

Some of the most interesting insects associated with this plant were Diptera. In May, 1919, a few maggots were found in the bases of the flower stalks near the ground level where the stem was solid pith. These maggots pupated on May 15 and two flies emerged on June 13. One of the flies was sent to Washington and the other was given to Frank R. Cole who in turn sent it to J. R. Malloch along with a specimen that he had obtained by sweeping. J. M. Aldrich determined the specimen sent to Washington as *Eremomyia* in 1920. It is not known whether Malloch, who was working on the genus at that time, described the species.

PHYTOMYZA ALBICEPS Meigan

On July 8, 1919, several small puparia were collected in debris inside the hollow part of the stems where papaipema larvae had also worked. On July 5, 1920, both larvae and puparia were observed and it was noted that the larvae had worked from the solid pithy core of the stem near the crown up the inside of the hollow stems, in the side walls, for two or three inches, causing a rusty color in the affected plant tissues. Flies emerged in March and April from material that had been kept over winter in the laboratory. These flies were determined as *Phytomyza albiceps* by J. M. Aldrich in 1921.

CHYLIZA LEGUMINICOLA Melander

On July 8, 1919, crowns and lower parts of the stems containing puparia were collected. These puparia were firmly held in the tissues of the crown, which the larvae had apparently mined. Adults emerged in March of the following year. The flies were swept from the host plants in April. Melander (1920) described this species from the writer's material as *Chyliza leguminicola*. In July, 1921, Miss Keen noted the larvae working in the base of the stems and in the crowns. In August, 1921, the writer collected infested crowns from which 39 individuals of this species and 49 specimens of another species emerged the following spring. On August 7, 1924, it was noted that the chyliza larvae worked in the crown of the lupine where the stem was originally solid. When full-grown and ready to pupate, they often mined downward into the root. The flies rarely attempted to fly when emerging in the laboratory but were quick to jump, like some chalcids.

LONCHAEA HIRTITHORAX Aldrich

On August 19, 1921, large numbers of maggots were found in a writhing mass where the stem of the lupine joined the crown, a part that is solid in undamaged plants. These larvae were thought to be *Chyliza* sp., but they were found to be of another species. In all, 49 specimens were reared. The species was described as *Lonchaea hirtithorax* by Aldrich (1925). On August 7, 1924, the lonchaea larvae were observed feeding in the thick walls of the lupine stems, near the crown but in the hollow part. They were not so abundant as they had been in 1921. By the time this species was feeding actively, the host plant had matured its seed and was on the decline. This species was still in the larval stage in August when chyliza larvae had pupated.

LYCORIA sp.

In May, 1922, *Lycoria* of an undetermined species were reared in considerable numbers from the roots and crowns that had been collected the previous summer.

HEMIPTERA

MACROSIPHUM ALBIFRONS Essig

The aphid *Macrosiphum albifrons* Essig has also been found on this lupine.

HYMENOPTERA

SOLIERELLA SIMILIS (Bridwell)

On August 17, 1920, a few nests of a sphecoid wasp were found in the flower stalks that had been broken off, part way down from the top, where they had been weakened by the feeding of *papaipema* larvae. One of these nests was in a stalk that had been broken near the crown, where it had been weakened by stem maggots, and was lying almost recumbent. In this case the wasp must have had to reverse its usual habit of forming its cells from the bottom up. The brood chambers were usually three to four in number and filled with three to six paralyzed but still living early stage grasshoppers of the genus *Melanoplus*, packed around with pellets of earth. The flimsy partitions between the cells, and the filling above the last cell, were formed of chaff, grass and weed seeds, small pieces of twigs, bird and insect excreta, and even a few very small berries. In one nest all the grasshoppers had been consumed and all the wasp larvae were in cocoons coated with fine dirt from the earth pellets. In another nest the two lowest chambers contained cocoons, the next higher chamber had a well-grown larva consuming one of the last grasshoppers, and the chamber nearest the top contained four grasshoppers with a small larva attached to one of them.

On August 24, 1920, two nests were discovered in lupine stems in a different locality from that of August 17. One of these nests was similar to those previously found and contained only cocoons, but the other was constructed differently, with only two large brood chambers, which contained more vegetable debris than earth pellets and 31 grasshoppers with only two well-grown larvae. The latter nest may have belonged to another species of wasp.

On August 19, 1921, Miss Keen found several of these nests in the lupine stems. All the wasp larvae were in cocoons and the provisions of grasshoppers had been consumed. Wasps that emerged from this material on June 28, 1922, were determined by S. A. Rohwer as *Silaon* n. sp. in 1922 and in 1924. These specimens are now in the U. S. National Museum under the name of *Solierella similis* (Bridwell), having been so identified by Francis X. Williams.³ A few parasites were also reared from cocoons of this wasp and were determined as *Tetrastichus* n. sp. by A. B. Gahan in 1923.

³Letter from C. F. W. Muesebeck, dated August 16, 1949.

On August 7, 1924, the writer found a nest that measured 13 inches over all and had 10 cells. The five lowest cells contained cocoons and the next three contained larvae. In the last cells there were 8 grasshoppers in one and 6 in the other, but no wasp larvae or eggs. These two cells were close together, with only a thin layer of trash between them and between the lower of the two and the next cell. The top end of the nest was filled with lumps of earth and other debris, dropped in haphazardly. The grasshoppers showed slight reflex movements when pressed on the sternal plates. Evidently these wasps began work early in July soon after emergence from the cocoons in which they had overwintered. At that time the grasshoppers would still be rather small in the wet places where the lupine grows as they hatch later in that area than elsewhere. The grasshoppers in the nests, probably *Melanoplus femur-rubrum* Degeer, were in the early nymphal stages.

MEGACHILE BREVIS Say, and COELIOXYS sp. near MOESTA Cresson

On August 7, 1924, the writer found a nest of a leaf-cutting bee in a hollow stem that had about one-third of the top broken off, probably because of damage by the *Papaipema* stem borer. This nest was $2\frac{3}{4}$ inches long and contained five cells. The partitions between the cells were made of three green leaves on top of each other with two pieces of rose petal, laid very closely together, as a cap to the cell below. The completed nest was about one inch below the opening of the hollow stem, and the stem above the last cell was filled with pieces of green leaves dropped in haphazardly. Another similar nest in the course of construction was observed. The last cell was formed of rose petals, still bright, and was open at the end and empty. Two completed cells below contained "bee bread" and one egg each. The eggs were attached to the side of the cell a few millimeters above the food. A newly hatched larva was seen but it was met and killed by a larger larva with large strong jaws, which had worked up through the "bee bread" in the bottom of the cell. In July of the following year, five bees of two species emerged from the undamaged nest. In 1927 Miss Grace Sandhouse determined one of these as *Megachile brevis* Say and the other four as *Coelioxys* sp. near *moesta* Cress. The latter species is an inquiline, and the larva with strong jaws noted above was probably this insect.

An intensive study of *Lupinus polyphyllus* would doubtless reveal other insects closely associated with it. The notes given in

this paper indicate that ecological studies of the insects associated with plants native to the Pacific Northwest would increase our knowledge of the insects of that region, some of which might eventually be of considerable importance to economic or ornamental plants.

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THE FEMALE OF PSEUDOMETHOCA ANTHRACINA (FOX) (Hymenoptera: Mutillidae)

Evidence has been obtained to substantiate Mickel's contention¹ that *Pseudomethoca harpalyce* (Fox)² is the female of *P. anthracina* (Fox)³. An analysis of the distributional patterns of the California *Pseudomethoca* fauna has revealed that those of *anthracina* and *harpalyce* are virtually superimposable. In the fall of 1947 at Antioch, California, a freshly emerged female (*harpalyce*) was caged and within a short time a male (*anthracina*) was actively attempting to enter the cage. On September 8, 1948, at the same locality, the sexes in question were observed and taken in copulo. In view of the above evidence, *Mutilla* [= *Pseudomethoca*] *harpalyce* Fox is regarded as a synonym of *Sphaerophthalma* [= *Pseudomethoca*] *anthracina* Fox.—PAUL D. HURD, JR.

¹Proc. U. S. Nat. Museum, 1924, vol. 64, p. 21.

²Trans. Amer. Ent. Soc., 1899, vol. 25, p. 227.

³Ent. News, 1892, vol. 3, p. 172.